Lung Cancer in Coastal Georgia: A Death Certificate Analysis of Occupation: *Brief Communication* [1]

J. Malcolm Harrington, *M.D.*, [2,3] **William J. Blot**, *Ph.D.*, [4,5] **Robert N. Hoover**, *M.D.*, [4] **W. Jere Housworth**, *B.S.*, [2] **Clark W. Heath, Jr.**, *M.D.*, [2] *and* **Joseph F. Fraumeni, Jr.**, *M.D.* [4,6]

ABSTRACT—A comparison of death certificate statements on occupation for 858 white males who lived in coastal Georgia counties and who died of lung cancer during 1961–74, and for 858 controls who were of the same age and county of residence revealed a twofold excess risk of lung cancer associated with the construction industry. No elevated risk of lung cancer was found for workers in the wood and paper industries in the urban areas of Savannah, Brunswick, or Waycross, but a threefold increase was uncovered for the remaining coastal counties where the wood and paper industry was the largest employer.—J Natl Cancer Inst 60: 295–298, 1978.

Mortality rates for lung cancer have been reported to be exceptionally high among white male residents in a series of counties along the Southeastern Atlantic coast of the United States (*1, 2*). As a preliminary step in the investigation of this excess risk, a study was made of occupations listed on the death certificates of persons who lived in Georgia coastal counties and who died of lung cancer.

METHODS

From computerized listing of deaths maintained by the State of Georgia for the years 1961–74, we identified 858 deaths attributed to primary lung cancer among white male residents of the following 12 coastal counties: Chatham, Glynn, Ware, Brantley, Bryan, Camden, Charlton, Liberty, Long, McIntosh, Pierce, and Wayne. Each lung cancer death certificate was matched by age at death within 1 year, year of death within 6 years, sex, race, and county of usual residence to a death certificate of a person who succumbed to conditions other than lung cancer, chronic respiratory disease, or bladder cancer. These disorders were excluded as controls because the occupational determinants may have been the same as those for lung cancer. Heart disease, stroke, and other circulatory diseases accounted for 58% of the control deaths, and cancer for 11%. The median age at death for both lung cancer patients and controls was 63 years. Nearly half the deaths occurred among residents of Savannah in Chatham County. The residents of Glynn and Ware Counties, which contain the other main aggregations of population, accounted for about 25% of the lung cancer deaths; the remaining 25% was divided among the nine rural counties along the Georgia coast. No major differences were found between lung cancer patients and controls with respect to marital status, place of birth, or duration of residence within the counties.

From the death certificate statement on usual occupation and kind of industry, each cancer patient and control was assigned a two-digit job category code. While using the major occupational titles employed by the U.S. Census Bureau (*3*), we, in our coding scheme, also attempted to categorize the individual's industrial involvement in one of 15 broad categories (*see* "Appendix"). Information on 91% of the certificates was specific enough for allocation in one of the two-digit codes 01–98. The analysis has been restricted to this group and particularly the industrial codes 05–79. We then compared the frequency of employment of lung cancer patients and controls in the various occupational and industrial categories. Summary relative risk estimates based on a matched-pairs analysis were calculated (*4*), with relative risk estimates by age at death, year of death, duration of residence, and county of residence subgroups being determined for several industrial classifications.

RESULTS

More lung cancer patients were employed in all levels of industrial jobs except management, whereas fewer lung cancer patients worked in professional, clerical, sales, and farming categories (table 1). Among the industrial categories, a twofold increased risk was associated with the construction industry and nearly a 50% increase with the chemical-related industry. About 25% more cancer patients than controls were in the two largest industrial categories, namely, wood and paper and transportation operation.

Table 2 shows estimated relative risks for selected industrial categories according to county of residence, age at death, and year of death of workers. The chemical-related industry included workers in chemical, petroleum, and rubber plants, but due to the system of coding, the largest number of individuals consisted

[1] Received June 9, 1977; accepted September 16, 1977.

[2] Cancer and Birth Defects Division, Bureau of Epidemiology, Center for Disease Control, Public Health Service (PHS), U.S. Department of Health, Education, and Welfare, Atlanta, Ga. 30333.

[3] *Present address:* TUC Centenary Institute of Occupational Health, London School of Hygiene and Tropical Medicine, Keppel St. (Gower St.), London WC1E 7HT, England.

[4] Environmental Epidemiology Branch, National Cancer Institute, National Institutes of Health, PHS, U.S. Department of Health, Education, and Welfare, Bethesda, Md. 20014.

[5] *Address reprint requests to* Dr. Blot.

[6] We thank G. W. Alan Dever, *Ph.D.*, and Thomas W. McKinley, *M.P.H.*, of the Georgia State Department of Human Resources for assisting us in obtaining death certificate data.

TABLE 1.—*Number of cancer patients and controls employed and estimated relative risks according to occupational and industrial categories*

Category	Cancer patients	Controls	Estimated relative risk[a]	Subgroup codes[b]
Occupation				
Industrial	595	539	1.13[c]	6
a) Managers	123	130	0.93	6
b) Craftsmen	234	205	1.18	6
c) Operatives	67	48	1.42[c]	6
d) Laborers	48	44	1.10	6
e) Not elsewhere classified	123	112	1.12	6
Service	64	61	1.05	4
Farming	77	86	0.87	5
Unknown	23	29	0.79	7
Clerical	22	28	0.76	2
Sales	42	61	0.67[c]	3
Professional	35	54	0.63[d]	1
Total	858	858		
Industry[e]				
Construction	48	24	2.04[f]	8
Utilities	8	5	1.60	11
Chemicals	55	39	1.46[c]	3
Stone	10	7	1.43	5
Wood and paper	97	78	1.28	6
Transportation operation	102	84	1.25	10
Electrical	14	12	1.17	7
Public administration	49	48	1.02	14
Transportation service	33	34	0.97	9
Not elsewhere classified	48	53	0.90	15
Wholesale, retail	45	50	0.89	12
Textiles	7	8	0.88	4
Metal	37	48	0.77	2
Food	39	49	0.77	1
Mining	3	0	∞	13
Total	595	539	1.13[c]	

[a] Values are based on matched-pair analysis; these estimated relative risks equal the No. of pairs in which the cancer patient, but not the control, was classified in the occupation category divided by the No. of pairs where the control, but not the cancer patient, was so classified.

[b] *See* "Appendix" for description of subgroup codes.

[c] $0.05 \leq P < 0.10$.

[d] $0.01 \leq P < 0.05$.

[e] *See* occupational codes 05–79 (*a*–*e*) in the "Appendix."

[f] $P < 0.01$.

of painters, so that the title "chemical-related" industry must be interpreted cautiously. The excess risk for workers in this chemical-related industry category occurred in all counties but appeared to be limited to persons who were over 65 years old and who died during the first half of the time period covered. Among construction workers, the relative risk was greatest at younger ages. No age or time differences were found for transportation operation workers, who were mostly railroad employees in Savannah and Waycross.

The only excess risk associated with the wood and paper industry (relative risk=3.3) was found in the smaller coastal counties but not in the three largest counties (Chatham, Glynn, and Ware). In these smaller counties, 20.1% of the cancer patients but only 7.2% of the controls were employed in the wood and paper industry. The wood and paper industry category was subclassified into 3 groups (pulp and paper workers; sawmill, lumber, and forestry workers; and carpenters), although the job titles for the first 2 groups showed considerable overlap. The increased risk was seen in all groups, but it was greatest among sawmill, lumber, and forestry workers.

DISCUSSION

Descriptive studies of lung cancer mortality in the United States have shown that some of the highest rates are found along the Gulf Coast and a 300-mile coastal strip that extends from Jacksonville, Florida, to Charleston, South Carolina (*1*). The reasons for these patterns are not clear, but a national correlation study suggested associations with the presence of paper, chemical, petroleum, and transportation industries (*2*). Since the paper and pulp industry is the dominant manufacturing industry along the Southeastern Atlantic coast, a review of death certificates was made as an initial step in the evaluation of this occupational clue. Inferences to be drawn from the death certificate data are obviously limited, since the statements on the certificates present at best a crude description of the "usual" occupation of the deceased, with no indication of length, variety, or detail of employment. However, the information may be useful in the defining and narrowing of hypotheses for further study.

A threefold excess risk of lung cancer among employees of the wood and paper industry was seen in rural Georgia counties but not in the "urban" centers of Savannah, Brunswick, or Waycross. The risk in the rural counties was not limited to paper mill employees as opposed to sawmill, lumber, or forestry workers. The urban–rural difference may be a chance observation or be due to confounding factors, but on the other hand, it may be indicative of differences in type and length of industrial exposures. A lack of uniformity was also seen in the national data, with excess lung cancer mortality in counties with paper-manufacturing industries in the Southeastern and Northeastern States but not in North Central and Northwestern States (*2*). A death certificate survey in the State of Washington uncovered no increase in lung cancer among workers in wood- and paper-related occupations (*5*), but a significant excess of lung cancer was reported among workers in the paper-manufacturing and sales industry in Los Angeles, California (*6*). A national probability survey of smoking patterns by occupation and industry has revealed high percentages of smokers among blue-collar employees, including painters, railroad employees, and some construction workers, but not particularly among carpenters, sawyers, and lumbermen (*7*). Further analysis of the mortality data is, however, inappropriate in the absence of accurate smoking histories.

The results of our review of Georgia death certificates also suggested an increased risk associated with construction jobs and a broad category of work involving

TABLE 2.—*Estimated relative risks for selected industries by county of usual residence, age at death, and year of death of workers*

Parameters	Relative risks for selected industries:[a]				
	Construction	Chemicals	Wood and paper	Transportation operation	Nonindustrial occupations[b]
County					
Chatham	3.3[c] (20)	1.3 (31)	1.0 (39)	1.5[d] (51)	0.7[d] (98)
Glynn	1.6 (8)	1.2 (6)	0.8 (11)	0.5 (6)	0.9 (28)
Ware	2.0 (4)	5.0 (6)	0.3 (3)	1.2 (25)	0.9 (36)
Other	1.5 (16)	1.8 (12)	3.3[c] (44)	1.3 (10)	0.7[d] (78)
Age at death, yr					
<65	2.6[c] (35)	1.0 (28)	1.3 (64)	1.3 (56)	0.8 (130)
65+	1.3 (13)	2.8[c] (27)	1.3 (33)	1.2 (46)	0.6[d] (110)
Yr of death					
1961–67	2.8[d] (14)	4.7[c] (32)	1.1 (42)	1.4 (40)	0.8 (121)
1968–74	1.8[d] (34)	0.8 (23)	1.4 (55)	1.1 (62)	0.7 (119)

[a] Values are based on matched-pair analysis; these ratios equal the No. of pairs in which the cancer patient, but not the control, was classified in the occupation category divided by the No. of pairs where the control, but not the cancer patient, was so classified. *Numbers in parentheses* = No. of cancer patients.

[b] Occupational titles 00–04 and 80–98 in the "Appendix."

[c] $P<0.01$.

[d] $0.01 \leq P < 0.05$.

possible exposure to various chemicals. To evaluate the role of these factors in the high risk of lung cancer among white male residents along the Georgia coast, we are presently obtaining lifetime smoking, occupational, and residence histories of recent (since 1970) lung cancer patients and controls, paying particular attention to workers employed in wood and paper, construction, and chemical-related industries.

APPENDIX: Occupation–Industry Codes

Code	Description
00–04	Professional, technical, kindred workers
05–79	Industry (15 categories) cross-classified by occupation (5 categories)

Subgroup code	Industries
1)	Food, drink, hotels, fishing camp
2)	Primary metal, fabricated metal, transportation manufacture
3)	Chemicals, petroleum, rubber, paints, printing, plastics
4)	Textiles, leather
5)	Stone, glass, clay, cement, asbestos
6)	Wood and paper
7)	Electrical
8)	Construction, not elsewhere classified
9)	Transportation service and repair, including gas stations
10)	Transportation operation, including trucking companies, railroads
11)	Utilities, telecommunications
12)	Wholesale, retail, auto dealer, hotel operator, beauty supply
13)	Mining
14)	Public administration, highway department, hospital
15)	Not elsewhere classified

Occupations

a) Managers, officials, proprietors
b) Craftsmen, superintendents, foremen, mechanics, machinists
c) Operatives, apprentices
d) Laborers (except farm)
e) Not elsewhere classified

80–82	Clerical
83–86	Sales workers
87–96	Service
97–98	Farmers and farm laborers
99	Unemployed or unknown

REFERENCES

(1) MASON, TJ, MCKAY FW, HOOVER R, et al: Atlas of Cancer Mortality for U.S. Counties: 1950–69. U.S. Dept Health, Educ. Welfare Publ No. (NIH) 75–780. Washington, D.C.: U.S. Govt Print Off. 1975

(2) BLOT WJ, FRAUMENI JF JR: Geographic patterns of lung cancer: Industrial correlations. Am J Epidemiol 103:539–550, 1976

(3) U.S. Bureau of the Census: Alphabetical Index of Industries and Occupations. Washington, D.C.: U.S. Govt Print Off, 1971

(4) MANTEL N, HAENSZEL W: Statistical aspects of the analysis of data from retrospective studies of disease. J Natl Cancer Inst 22:719–748, 1959

(5) MILHAM S JR: Neoplasia in the wood and pulp industry. Ann NY Acad Sci 271:294–300, 1976

(6) MENCK HR, HENDERSON BE: Occupational differences in rates of lung cancer. J Occup Med 18:797–801, 1976

(7) STERLING TD, WEINKAM JJ: Smoking characteristics by type of employment. J Occup Med 18:743–754, 1976